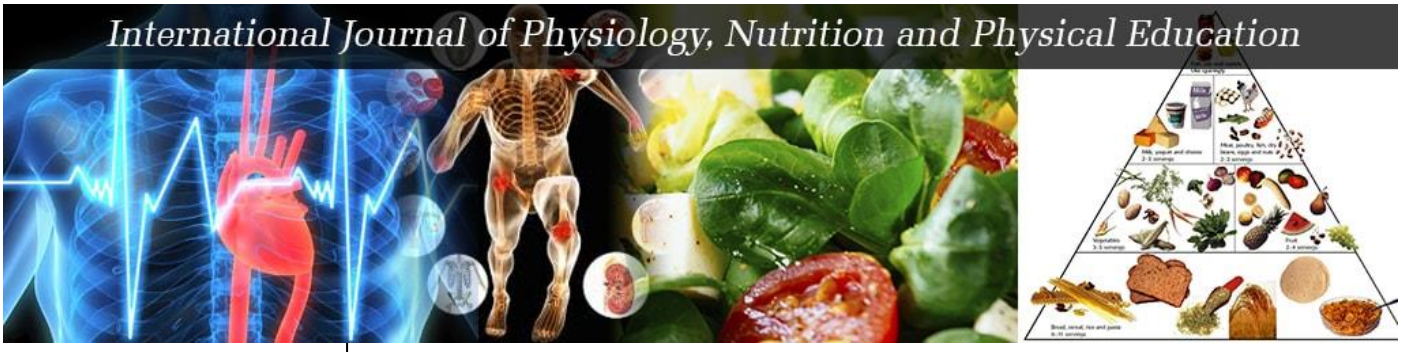

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Kinematic analysis of jump serve performance among volleyball players

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Abstract
Aim: Aim of the present study was to compare kinematic parameters of jump serve performance between undergraduate and post graduate volleyball players.
Methods: Sixteen (N=16, 8 undergraduate, 8 postgraduate) male physical education students active in volleyball with the following measurements were chosen for the study: (for undergraduate Height; 176.68±6.22, Weight; 69.04 ± 6.28, and Age; 20.86 ± 2.32), (for postgraduate Height; 178.46 ± 3.28, Weight; 74.04 ± 7.26, and Age; 22.42 ± 2.34).
Results: Mean linear velocity and mean linear acceleration is higher for PG volleyball players than the UG volleyball players. Elbow angle and Knee angle were observed with significant difference at 't' 0.05 (2,14)= 1.761 in which observed 't'= -1.841, 1.840 for Elbow angle & Knee angle respectively.
Conclusion: On the basis of the results obtained from the present empirical investigation it can be concluded that both the groups had same technical efficiency which was close to that of elite players.

Keywords: Kinematic parameters, undergraduate volleyball players, post graduate volleyball players

Introduction
For more than a century, volleyball has been played all over the world. According to estimates, it is one of the most popular game around the world. A serve starts the play in volleyball. The serve, which is typically overhand but can also be topspin or float, may be made. Furthermore, a standing or jump start may be used to execute the serve (Huang & Hu, 2007) [4]. In volleyball, the jump serve is one of the most thrilling serves because it delivers more pleasant dynamic skill and is captivating for both players and spectators. During the course of a match, a fantastic jump server can generate a number of successful attempts. Consequently, it has developed into a potent offensive tool for the best volleyball teams in the world. One of the most daring and thrilling techniques in the current game of volleyball is the jump serve (Bhasi & Sadanandan, 2022) [3].

Numerous professional volleyball players employ the jump topspin serve and jump float serve in international competition. A topspin serve is delivered with a throw from the baseline and a hop into the court to spike the ball in the direction of the opposition. Because of the tremendous topspin (and occasionally sidespin) applied to the ball, it is challenging for the opponents to correctly receive and pass the ball to the setter. The jump float serve is supposed to have little spin and float with the unpredictable air currents before descending sharply onto the opposing court. It has a similar preparatory action to the jump spin serve. The jump serve has become increasingly crucial in determining the outcome of games ever since the new rule Rally Point System was adopted in the year 2000. The athlete must practise the proper serve skills in order to master the volleyball jump serve. Understanding how professional athletes execute the jump serve can help coaches teach athletes the proper spiking techniques (Huang & Hu, 2007) [4]. In men's top international volleyball, the serve is highly significant. Strong serves are an effective offensive weapon that may both directly score points and help the block and defence score points (Palao *et al*., 2004) [6].

In previous study of jump serve, velocity of jump serve was predicted and it had shown a positive relationship with centre of gravity and distance of jump whereas a negative relationship with trunk flexibility (C.R, 2021) [1]. A study "Kinematic analysis of velocity of

jump serve among national level volleyball players" was conducted and findings of the study revealed about positive relationship of velocity of the ball with take-off velocity, height of CG at ball contact, reach height and distance of jump (Bhasi & Sadanandan, 2022) [3]. But none of the study has discussed about comparison of linear and angular kinematics between undergraduate and postgraduate students who were part of regular volleyball training.

Therefore, the aim of the present study was to compare kinematic parameters of jump serve performance between undergraduate and post graduate volleyball players.

Methods

Participants

Sixteen (N=16, 8 undergraduate, 8 postgraduate) male physical education students active in volleyball with the following measurements were chosen for the study: (for undergraduate Height; 176.68±6.22, Weight; 69.04±6.28, and Age; 20.86±2.32), (for postgraduate Height;178.46±3.28, Weight;74.04±7.26, and Age;22.42±2.34)

Kinematic Parameters assessment

Selected kinematic parameters (Linear velocity of arm swing, Linear acceleration arm swing, Wrist joint angle, Elbow joint angle, Shoulder joint angle, Trunk joint angle, Knee joint angle & Ankle joint angle) were assessed in the standardized volleyball court of LNIPE NERC Guwahati. All the measurements were taken from dominant side of the body. A familiarization session was also conducted 1 day prior to the testing for all the subjects participating in the study. Prior to assessment each subject was asked to warm up for at least 15minutes by stretching all major muscles involved in the jump serve movement pattern. After warm up subjects were asked to perform jump serve, three attempts were given to each subject and execution of jump serve was under the supervision of qualified coach/ expert in volleyball. Best technical execution in which ball landed inside the court was considered for kinematic analysis. 30 seconds recovery was given between consecutive attempts.

Filming protocol

For the kinematical data a high speed Canon Legria HF S10 camcorder operating at 1/2000 with a frame rate of 120 frames per second was used to capture the spike serve performance. The camcorder was placed perpendicular at a distance of 05 meter on the right side of the players mounted at a height of 1.35 meter above the ground and video clips were captured in middle fifty percentage of the movement execution during jump serve. Reflective markers were also placed on the joints and vertical as well as horizontal references were inducted to minimise error. The recorded video footages were downloaded, slashed and edited by using the kinovea software. Digitization, smoothing and analysis was also performed using the same analysis software.

Statistical analysis

IBM SPSS version 20 was used for all statistical analyses (IBM, New York, USA). The mean and standard deviations of the data are presented. The Shapiro-Wilk test was used to determined normality. Both the groups were compared using independent sample 't' test. The level of statistical significance was set at $p \leq 0.05$.

Results

In order to assess significant difference for linear velocity and linear acceleration between UG & PG volleyball players, Mean, SD & SE (Mean) of subjects were reported in the in Table 1.

Table 1: Comparison of Linear velocity and acceleration of Arm swing between UG and PG male volleyball players

Variable(s)	UG (N=8)			PG (N=8)			't' Ratio
	Mean	SD	SE (Mean)	Mean	SD	SE (Mean)	
Linear velocity	0.537	0.17	0.60	0.544	0.86	0.31	- 0.185
Linear acceleration	0.29	0.05	0.17	0.30	0.04	0.15	-0.193

Legend: * Statistically significant to a level of 0.05 (Student-T Test for independent samples).

From table 1 it is evident that Mean linear velocity and Mean linear acceleration is higher for PG volleyball players than the UG volleyball players. However this difference is not statistically significant at 't' 0.05 (2,14)= 1.761, which is higher than the observed 't' ratio (t= -0.185 for linear velocity & -0.193 for linear acceleration).

Table 2: Comparison of Segmental angles of Shoulder, Elbow, Wrist, Trunk, Knee and Ankle between UG and PG male volleyball players

Variable(s)	UG (N=8)			PG (N=8)			't' Ratio
	Mean	SD	SE (Mean)	Mean	SD	SE (Mean)	
Shoulder Angle	151.50	14.90	5.27	161.37	6.37	2.25	-1.723
Elbow Angle	132	12.76	4.51	144.37	14.09	4.98	**-1.841***
Wrist Angle	159.37	11.71	4.14	165.37	13.05	4.61	0.967
Trunk Angle	186.25	15.80	5.59	186	13.14	4.65	0.034
Knee Angle	158.87	14.48	5.12	145.13	15.39	5.44	**1.840***
Ankle Angle	128.87	9.85	3.48	130.75	13.53	4.78	-0.317

Legend: * Statistically significant to a level of 0.05 (Student-T Test for independent samples).

From table 2, It is apparent that maximum and minimum mean values for angular kinematics were obtained for UG players; (Trunk angle; 186.25 and Ankle angle; 128.87). Out of all the selected angular kinematic variables, Elbow angle and Knee angle were observed with significant difference at 't' 0.05 (2,14)= 1.761 in which observed 't'= -1.841, 1.840 for Elbow angle & Knee angle respectively.

Discussion

Aim of the present study was to compare kinematic parameters of jump serve performance between undergraduate and post graduate volleyball players.

In present study. It was hypothesised that there would be no difference between UG & PG volleyball player's kinematic parameters during jump serve and null hypothesis was also rejected in case of angular kinematics (Elbow joint angle &

Knee joint angle) whereas for other kinematic parameters, researcher failed to reject the null hypothesis. The results of the present study indicated absence of significant differences between UG and PG male volleyball players in the linear velocity of arm swing and linear acceleration of arm swing. The potential reason for insignificant differences might be due to player's identical technical proficiency and playing level. Further significant differences were observed between these two groups in terms of segmental angles of Elbow joint and Knee joint and this might be due to the fact that the variation in the ball height, jump height, ball velocity and hand velocity of UG is less than PG male volleyball players (Hsieh, 2008). Secondly insignificant differences were obtained in other body segmental angles (Ankle, Trunk, Shoulder and wrist). The angle of the segments during spike serve between UG and PG may be same but the movement forces applied on the ball may be differ and not dependent on the angle of segment but on the speed of change of angle which is return increased the velocity of segment to transfer to the ball. Here we also found that when the arm swing velocity was higher the ball velocity was also higher (Hussain *et al*., 2013).

Conclusion

On the basis of the results obtained from the present empirical investigation it can be concluded that both the groups had same technical efficiency which was close to that of elite players and both the groups must emphasize on arm swing velocity as it might be a contributing factor for ball velocity.

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